Food Hydrocolloids 51 (2015) 200–216

Contents lists available at ScienceDirect

Food Hydrocolloids

journal homepage: www.elsevier.com/locate/foodhyd

Review

Biological effects of chitosan and its derivatives

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ARTICLE INFO

Article history:
Received 3 November 2014
Received in revised form
9 May 2015
Accepted 14 May 2015
Available online 22 May 2015

Keywords:
Chitosan derivatives
Biological activities
Reactive oxygen species
Antioxidant
Chronic diseases

ABSTRACT

Chitosan is a natural nontoxic biopolymer produced by alkaline deacetylation of chitin. Chitin and chitosan are insoluble in water as well as most organic solvents. Chito-oligomers (COS), depolymerized products of chitosan, has received much attention in biomedical, food, pharmaceutical, agricultural and environmental industries due to their biocompatible, biodegradable, non-toxic and non-allergenic natures. Chitosan and its derivatives have been shown to possess diverse biological activities, including antioxidant, anti-hypertensive, anti-coagulant, anti-diabetic, anti-obesity, anti-allergic, anti-inflammatory, anti-microbial, anti-cancer, neuroprotective and matrix metalloproteinases inhibitory effects. Thus, this overview mainly focuses on biological effects of chitosan and its derivatives as well as presents their potential applications as ingredients in functional foods and nutraceuticals for the prevention or treatment of chronic diseases.

Contents

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http://dx.doi.org/10.1016/j.foodhyd.2015.05.023
0268-005X/

1. Introduction

Chitin (Fig. 1), poly (β-(1–4)-N-acetyl-D-glucosamine), is a major component of the shells of crustaceans such as crab, shrimp and crawfish. Chitosan (Fig. 1) is a natural nontoxic biopolymer produced by alkaline deacetylation of chitin. Chitin and chitosan are insoluble in water as well as most organic solvents, which is the major limiting factor for their utilization in living systems. Chito-oligomers (COS) (Fig. 1) are the degraded products of chitosan or chitin prepared by enzymatic or chemical hydrolysis of chitosan. Chitosan and its derivatives were applied in many fields such as biomedicine, food, cosmetics, agriculture, environmental protection, water- and waste treatment due to their biocompatible, biodegradable, non-toxic and non-allergenic natures (Muzzarelli, 2009; Muzzarelli, Stanic, & Ramos, 1999).

Chitosan and its derivatives have attracted considerable attention as biomedical materials, owing to their unique biological effects such as antioxidant, anti-allergic, anti-inflammatory, anti-coagulant, anti-cancer, anti-bacterial, anti-human immuno deficiency virus, anti-hypertensive, anti-Alzheimer's, anti-diabetic, anti-obesity and matrix metalloproteinases inhibitory activities (Dash, Chiellini, Ottenbrite, & Chiellini, 2011; Prashanth & Tharanathan, 2007).

Chitosan has three types of reactive functional groups, an amino/acetamido group as well as both primary and secondary hydroxyl groups at the C-2, C-3 and C-6 positions, respectively. The amino contents are the main factors contributing to the differences in their structures and physico-chemical properties. Moreover, their random distribution makes them easy to generate intra- and inter-molecular hydrogen bonds. Another important characteristic to consider for chitosan is the molecular weight (MW) or chain length and its distribution (Zhang et al., 2010). By modulating and improving physiological functions, chitosan and its derivatives may provide novel therapeutic applications for the prevention or treatment of chronic diseases. This review centers on biological activities of chitosan and its derivatives and their potential applications as ingredients in functional foods and nutraceuticals to prevent and treat chronic diseases.

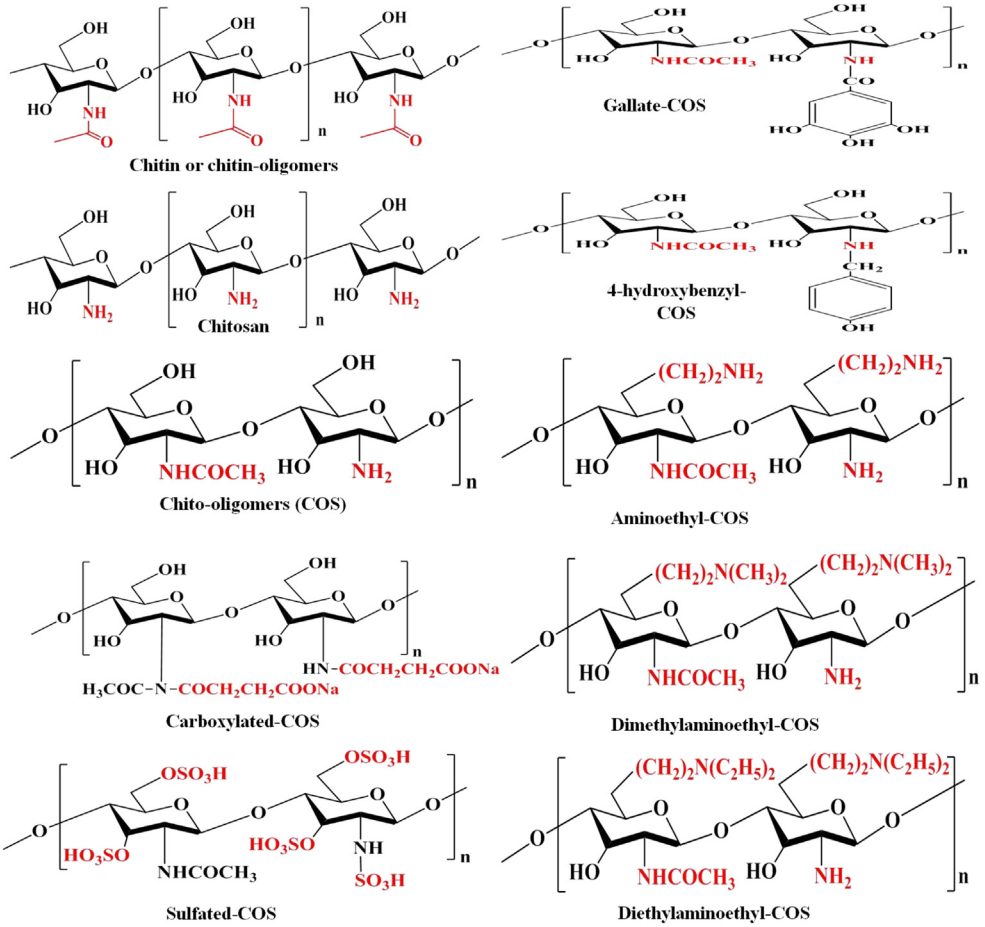

Fig. 1. Structure of chitin, chitosan, chito-oligomers and their derivatives.